

Messy supply chains

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Abstract

Extant research has made many advances in our understanding of how relatively stable, repetitive supply chains (SCs) can be run effectively. This study focuses on the less researched SCs that are not stable or repetitive. To capture the management challenges of this type of SC, a definition of "messy supply chains" (MSCs) for SCs presenting "wicked" (Rittel and Webber, 2007) or "messy" problems (Ackoff, 1981) is proposed. A conceptual framework is explored in the context of the literature on humanitarian operations. This framework will form the foundation of an in-depth examination of MSCs to aid research and managerial practice.

Keywords: supply chain management, messy problems, wicked problems, humanitarian logistics

Topics: supply chain management, humanitarian operations and crisis

Messy Supply Chains

Conventionally, supply chains (SCs) are depicted as linear connections including the flow of materials, information and money through several tiers of suppliers to a focus company and on to customers until they ultimately reach the end consumer (for example Mentzer et al., 2001, Mangan et al., 2008, Waters, 2009, Chopra and Meindl, 2010, Harrison and Van Hoek, 2011). This is the basic underlying principle of much of the relevant academic literature. However, over time, differences in SCs have garnered increasing levels of attention. In the operations management literature, different types of SCs have been discussed. Fisher (1997) distinguishes between efficient SCs for functional products and responsive SCs for innovative products, basing this

differentiation mainly on the characteristics of the physical products customers demand. Well-known SC types are lean and agile SCs (for example Christopher, 2000; Mason-Jones and Towill, 1999; Mason-Jones et al. 2000). Lean SCs are noted for their high emphasis on efficiency, while agile ones are primarily concerned with flexibility in responding to unpredictable demand patterns.

These differentiations have been the foundation of numerous academic studies, as well as industry practices. However, they assume stable and repetitive operating characteristics, such as predictable demand patterns for certain products that a SC provides. This does not capture the high levels of complexity that some types of SCs exhibit. The notion of uni-directional, linear SCs has changed significantly over the last decades. Reverse logistics is gaining importance as the rate of returns from e-commerce purchases rises and disposal or recycling of products creates additional flows of goods from customers (Alvarez-Gil et al., 2007, Mollenkopf et al., 2007, Pochampally and Gupta, 2008). A recent focus on services SCs has revealed bidirectional interactions with both customers and suppliers (Maull et al., 2012). As the business environment becomes increasingly vulnerable, SCs need to exhibit higher levels of flexibility, not merely in reacting to fluctuating demand, but also in adapting their structures to changes in their wider operating context (Christopher, 2005). Uncertainty, fluctuating organisational structures and the need to accommodate a range of differing and often conflicting demands from stakeholders have become features of many SCs (Day et al., 2012). However, much of the growing body of SC management literature concentrates on SCs with mature attributes, such as stable organisational structures, a certain level of predictability, and agreement on the aims of a SC, as well as the acceptable ways of achieving those aims. SCs with less mature operating characteristics receive less attention.

This study focuses on a particular type of SC that is non-linear, highly complex and has a significant impact on stakeholders and society as a whole. To wholly capture the management challenges presented by this type of SC, this paper introduces the term "messy supply chains" (MSCs) for SCs that deviate from the above norms, presenting "wicked" (Rittel and Webber, 1973), or "messy" problems (Ackoff, 1981). Key characteristics of MSCs are established through a review of literature on "messy" problems. These problems are the subject of cross disciplinary academic literature. Therefore, attributes of "messy" problems as identified by academics from disciplines beyond the boundaries of SC management or operations management, have been taken into account in defining MSCs. The study provides an analytical framework for MSCs, which is then explored in the context of humanitarian logistics.

Wicked Problems, Messy Problems and Wicked Messes

Complex problems that involve the wider environment and have political and social dimensions, beyond their mere technical or operational issues, have been called wicked (Rittel and Webber, 2007) or messy (Ackoff, 1981). Messy problems are "complex, emergent, interdependent problems spiralling near the edge of chaos" (Calton and Payne, 2003, p. 7). Wicked problems are defined as "social systems problems which are ill-formulated, where the information is confusing, where there are many clients and decision makers with conflicting values, and where the ramifications in the whole system are thoroughly confusing" (Churchman, 1967, p. 141). Both concepts stress the complexity of the situations they address and acknowledge that they are outside of the limits of rational control (Habermas, 1987). Work on wicked and messy problems started in the late 1960s when significant technical problems had been overcome culminating in the moon landing, but the world was also facing complex social

problems signified for example by the civil rights movement in the USA (Skaburskis, 2008). Based on these experiences, Rittel and Webber (1973) examined the differences between scientific problems and social problems, thus defining the nature of wicked problems.

An understanding of different problem types is essential for any attempt to solve messy or wicked problems. Mistaking them for a tame problem, ignoring the inherent complexity, can mask larger issues and undermine any future attempts to identify solutions (King, 1993). Roth and Senge (1996) introduced a matrix (Figure 1) that distinguishes problem types according to the complexity characteristics they exhibit.

Tame problems are defined as those in which common values are shared among stakeholders leading to a clear understanding of right or wrong approaches and solutions, and in which outcomes can easily and directly be linked to actions undertaken. Wicked problems are characterised by high behavioural complexity which signifies a diverse set of values among decision makers and considerable disagreement about assumptions and goals (Hancock, 2010). Messy problems exhibit high levels of dynamic complexity. None of their constituent parts can be solved in isolation as they display a high level of systems interaction (Hancock, 2010). Wicked messes combine high behavioural complexity with high dynamic complexity. Roth and Senge (1996) define them as “systems of interlinked problems [that] interact with the misunderstandings, divergent assumptions, and polarised beliefs of different groups” (p. 95) and highlight the tendency of decision makers to focus on curing symptoms rather than examining underlying causes which stakeholders cannot agree upon.

		Dynamic Complexity	
		Low	High
Behavioural Complexity	Low	Tame Problems	Messy Problems
	High	Wicked Problems	Wicked Messes

Figure 1 - Problem types according to Roth and Senge (1996, p. 93)

While tame problems can usually be solved by adopting a linear style of problem solving, this approach is futile when dealing with other classes of problem, particularly wicked messes (Ritchey, 2011). It is therefore essential to identify problem types correctly. Taking a systems thinking perspective of SC management, it can be assumed that SC problems consist of a multitude of interlinking systems (Naslund, 2002). This corresponds with a high dynamic complexity, making SCs messy problems according to Roth and Senge (1996). SCs that additionally exhibit elements of behavioural complexity would be classified as wicked messes. In the following, characteristics of

wicked messes in SC management will be developed based on a review of relevant literature. The term used for these wicked messes is “messy supply chains” (MSCs). Once these characteristics have been established, the resulting framework is then applied to a particular type of SC, humanitarian logistics, which is assumed to be likely to display elements of behavioural complexity because of its inherently social nature. Using evidence from relevant literature, each element of the framework for MSCs is explored in the context of humanitarian logistics.

Characteristics of Messy Supply Chains

Messiness and wickedness are established concepts in management literature, as has been explored in the previous section. In the modern world, an increasing number of problems display these characteristics (Mingers, 2006, Camillus, 2008). The first characteristic of MSCs is their high level of dynamic complexity as they present systemic challenges (Churchman, 1967, Roth and Senge, 1996). According to Ackoff (1981), messy problems consist of multiple, interlinked problems that add to their complexity.

Furthermore, messy problems lack structure and are usually non-routine occurrences (Mintzberg et al., 1976, Holt, 2004). This adds to their high levels of dynamic complexity. The problems are often based on assumptions rather than known fact and cannot be solved easily based on knowledge gathered in solving previous problems (Mitroff and Mason, 1980, Hancock, 2010).

Wicked messes are particularly common where societal issues are involved in scientific problems, making ethics an important concern (Calton and Payne, 2003, Camillus, 2008). The difficulties in actually formulating a wicked/messy problem make them even more political (Lyles and Mitroff, 1980, Skaburskis, 2008, Baer et al., 2013). The broad issues at the core of wicked messes have a significant impact on society (Churchman, 1967, Mitroff and Mason, 1980, Holt, 2004).

A multitude of different parties is involved in wicked messes (Roth and Senge, 1996, Beattie et al., 2012). These stakeholders, with their distinct identities and complex relationships contribute to the messiness (Calton and Payne, 2003, Ackermann, 2012). In addition, there is a behavioural complexity inherent in wicked problems because the stakeholders do not possess a unified set of values, thus making agreement on desirable outcomes or even possible approaches difficult (Ritchey, 2011). Therefore, it is even more important to approach such problems from a variety of angles (Wagner, 1995), enabling collective learning through stakeholder involvement (Calton and Payne, 2003, Hancock, 2010). As a result, stakeholders contribute to the messiness of a situation, but also help to identify potential solutions.

Wicked messes are problems that are not clearly defined and have broad boundaries (Lyles, 2013), they range from difficult to impossible to quantify, and therefore present a challenge to computer-based decision support, as well as linear problem-solving techniques (Wagner, 1995, Hancock, 2010). Generally, inflexibility and excessive structure become an issue when dealing with messy problems (Lyles, 2013). The numerous variables they encapsulate often result in attempts to “tame” wicked messes. However, ignoring key factors makes it impossible to offer the best solution (Churchman, 1967, Carrithers et al., 2008, Lyles, 2013). New, creative ways of interacting with stakeholders are needed to approach such problems (Eisenhardt, 2000). A very high level of critical thinking capabilities is required to approach these problems and to justify the “best” solution, rather than finding the right answer (Carrithers et al., 2008). There are always plausible alternative solutions to wicked messes, making it

impossible to determine when to stop looking for an optimal solution (Holt, 2004). In summary, MSCs exhibit five key characteristics:

1. They present complex, interdependent problems (Ackoff, 1981, Calton and Payne, 2003, Mingers, 2006)
2. They have significant sociopolitical impact (Mintzberg et al., 1976, Mitroff and Mason, 1980, Camillus, 2008)
3. They are non-routine operations (Lyles and Mitroff, 1980, Calton and Payne, 2003, Camillus, 2008, Baer et al., 2013)
4. They have a multitude of stakeholders with differing sets of values (Wagner, 1995, Ackermann, 2012, Beattie et al., 2012)
5. They lack optimal solutions derived from quantifiable evaluation (Wagner, 1995, Eisenhardt, 2000, Carrithers et al., 2008, Lyles, 2013)

These criteria apply to a multitude of SCs. For example, socio-political aspects in SCs can be concerns about carbon emissions or corporate social responsibility (CSR) (Simpson et al., 2007, Anner, 2012, Cruz, 2013). Non-routine operations are transient supply chains that are quickly formed for a specific purpose, but change dynamically and can be disbanded quickly (Day et al., 2012); an example could be the SCs for the Olympic Games (Horn, 2012). A multitude of stakeholders can be linked to socio-political concerns (Buysse and Verbeke, 2005, González-Benito and González-Benito, 2006), but it is a particularly prominent issue in service SCs (Maull et al., 2012). While one or more of the five characteristics may occur in various types of SCs, a MSC is defined as a SC that contains all five of them. Table 1 illustrates some of the key differences between MSCs and standard SCs. Standard SCs is used to signify those SCs with mature characteristics that are most commonly covered in the literature.

Table 1 – Difference between Messy Supply Chains and Standard Supply Chains

Messy Supply Chains	Standard Supply Chains
Complexity and interdependency	Consist of a structured set of problems (Waters, 2009, Chopra and Meindl, 2010, Harrison and Hoek, 2011)
Socio-political impact	Present mainly technical problems, based in engineering (Voß and Woodruff, 2006, Gattorna, 2009)
Non-routine operations	Standardised operations with a certain level of predictability despite some uncertainty (Fisher, 1997, Mason-Jones et al., 2000, Taylor and Brunt, 2001)
Multitude of divergent stakeholder values	Agreement on basic parameters of the supply chain (Gunasekaran et al., 2004, Christopher, 2005)
No optimal solutions from quantifiable evaluations	Possibility to model SCs and find an optimum solution based on quantitative data sources (Geunes et al., 2005, Christou, 2012)

The five characteristics identified are depicted in Figure 2 according to the systems complexity and the behavioural complexity they signify. These two different

complexities are essential to the previously discussed wicked messes and help to situate the conceptual framework in the wider body of literature. This framework is subsequently used to examine the concept of MSCs in the context of humanitarian operations.

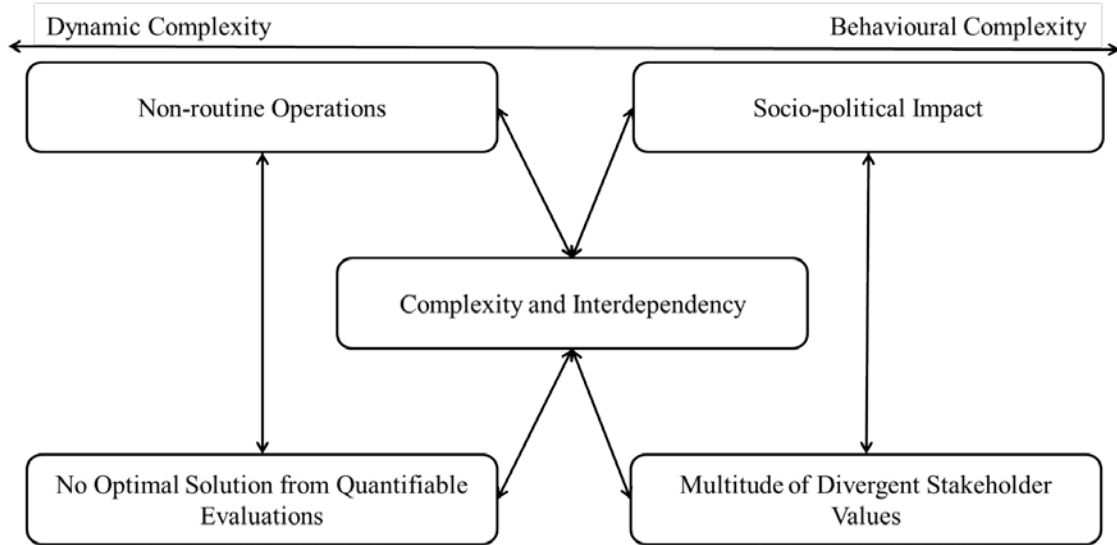


Figure 2 – A conceptual framework for messy supply chains

Humanitarian Logistics as an Example of Messy Supply Chains

Humanitarian logistics (HL) is used in this paper to encompass all logistics and SC activity related to humanitarian relief operations that occur after disasters. Tatham and Pettit (2010) estimate the humanitarian sector's annual expenditure at more than US\$25 billion. SC and logistics activities comprise as much as 60-80% of the total cost of humanitarian operations (Van Wassenhove, 2006, Blecken, 2010). This makes efficient and effective HL vital from an economic standpoint, in addition to the moral imperative underlying humanitarian operations. To examine the potential contribution of a MSC approach, informed by previous work on managing and solving wicked and messy problems, this study examines HL as potential examples of MSCs. To address this research question, the previously established components of the framework for MSCs are explored in the context of HL. Figure 3 gives an overview of the evidence of MSC characteristics in HL. Indicative references are given for each of the aspects listed.

The complexity of HL is due to factors such as the wide geographical spread often in less-developed regions of the world in difficult operating environments characterised by political and social unrest, as well as a lack of functioning infrastructure. The actual operational disaster relief is dependent on periods of strategic planning, as well as a complex interplay of entities across the globe. The high social impact of HL is evident in the relationship with beneficiaries, but there is also a wider political impact in the linkages with governments both as donors and as recipients. Since HL is dependent on donations, it is invariably tied to politics and organisations are in fierce competition for funds. HL operates under conditions of extreme uncertainty, often lacking even the most basic of technologies and amenities of standard SCs. The environment is changing constantly as social, political and natural forces interact after a disaster. In addition, there is at present very little evidence of organisational learning from one HL operation to the next. Characteristic of HL is the involvement of large numbers of diverse stakeholder groups. These range from local to global, include non-profit and for-profit entities, as well as governments, military groups and beneficiaries. Conflicting agendas

and cultures lead to a lack of a shared understanding of the problems presented by HL. Furthermore, there is no single customer group with well-defined preferences in HL. Ultimately, there cannot be one solution to the problem posed by HL. Little data is available to evaluate potential alternative solutions. As no stakeholder has a complete view of the problem, each can only attempt to solve individual aspects of it. HL is also cyclical and as such can never come to an end.

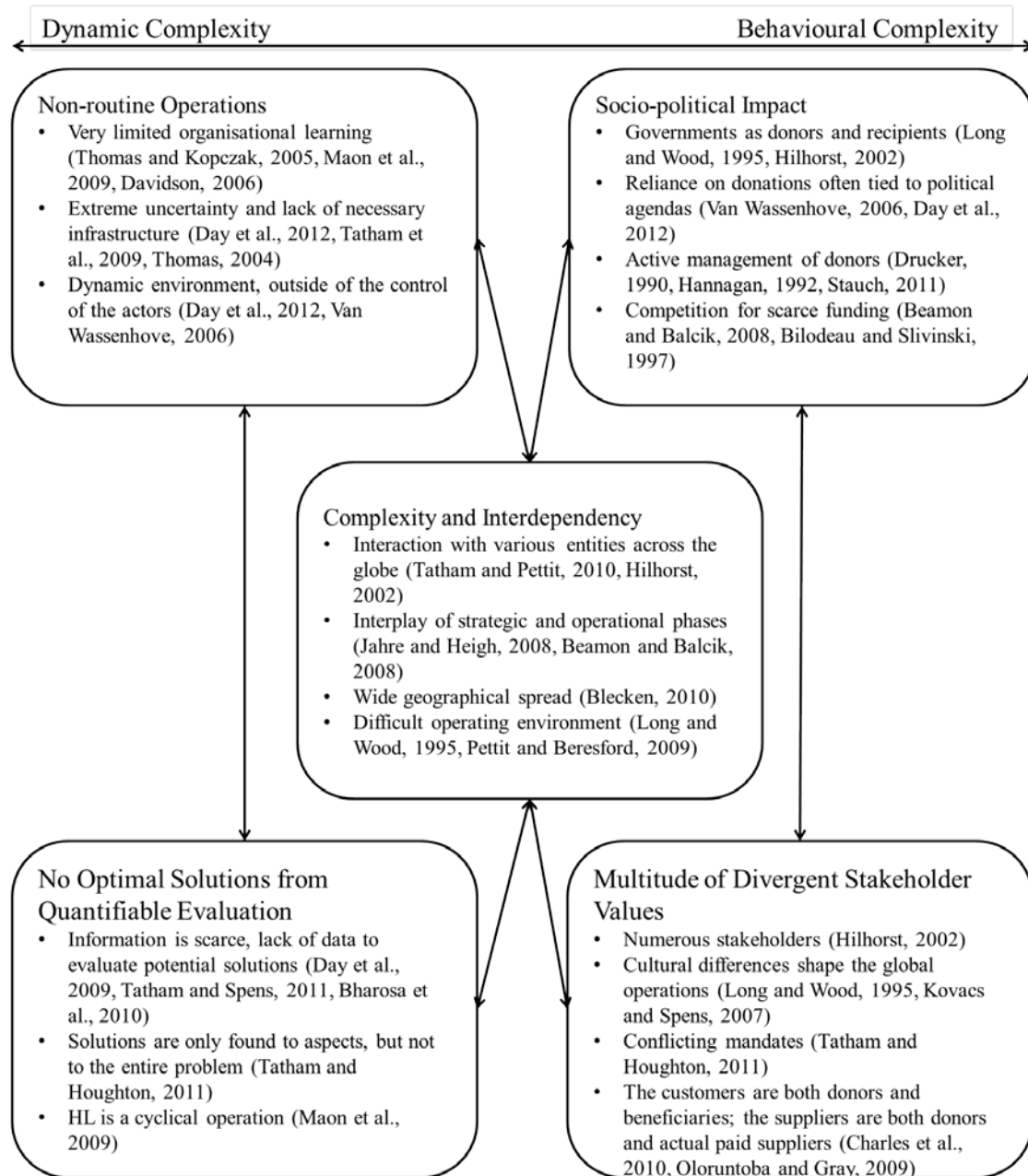


Figure 3 – Characteristics of Messy Supply Chains in Humanitarian Logistics

Conclusion

It has been suggested, by using examples from the relevant literature, that all five of the previously identified characteristics of MSCs are evident in HL. Suggesting therefore that HLs can be modelled as MSCs. Humanitarian supply chains are complex, dynamic systems (Gonçalves, 2008). Apart from the impact of humanitarian supply chains on beneficiaries' lives, their reliance on donations also creates socio-political effects in

funding (Van Wassenhove, 2006, Beamon and Balcik, 2008). Particularly disaster relief operations are non-routine with sparse evidence of continuity or organisational learning (Thomas and Kopczak, 2005, Maon et al., 2009). The relationships with a network of stakeholders contributes significantly to the messiness of humanitarian supply chains (Kovacs and Spens, 2009). Information management is difficult, leading to unclear and rarely quantifiable data on humanitarian supply chains (Day et al., 2009).

The proposed analytical framework for MSCs provides an in-depth examination of the complexities of a particular type of SC. It considers messiness and wickedness from an inter-disciplinary perspective, accessing a rich body of literature that can add to research in SC and logistics management and aid in the understanding and management of chains that possess characteristics of behavioural and dynamic complexity.

Further research should focus on the existence of messy and wicked characteristics in a variety of SCs, with particular significance being placed on evidence from practice, particularly regarding the management and problem solving techniques that are employed in such SCs. These can then be contrasted with the discussion of wicked messes in a variety of contexts, for example information systems design (Guindon, 1990, Harrell and Sage, 2010), food policy (Anthony, 2012, Norton, 2012) or risk management (Holt, 2004, Hancock, 2010). Insights can then be employed to tackle the issues posed by MSCs more successfully, to achieve more efficient and effective SCs.

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